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Original Research

Association between Pelvic Floor Dysfunction and Pelvic Floor Ultrasonography Evaluation in Pregnant Women: A Cross-Sectional Study

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Abstract

Background: Pelvic floor dysfunctions (PFDs) are commonly encountered in pregnancy, which may include urinary and fecal incontinence, pelvic pain, sexual dysfunction and pelvic organ prolapse. Identifying these problems and their risk factors in pregnancy is crucial for prevention and management. The primary outcome of this study is to investigate the relationship between the PFD symptoms in pregnant women and perineal ultrasonography measurements. Secondary outcomes are to figure out the risk factors for PFDs in pregnancy and also to identify the relationship between these risk factors with transperineal ultrasonography measurements and pelvic floor muscle strength (PFMS). **Methods**: 49 pregnant women recruited in the study, were asked to fill questionnaires, underwent transperineal ultrasonography and pelvic floor muscle strength examination. **Results**: The hiatal area at rest, pelvic contraction and Valsalva are positively correlated with stress urinary incontinence (SUI) (p = 0.018, p = 0.003 and p = 0.006 respectively), pelvic organ prolapse (POP) (p = 0.015, p = 0.022 and p = 0.011 respectively) and sexual dysfunction (SD) (p = 0.033, p = 0.041 and p = 0.023 respectively). Hiatal area at Valsalva and detrusor muscle thickness are positively correlated with urge urinary incontinence (UUI) (p = 0.021 and p = 0.012). The hiatal area value at pelvic contraction and Valsalva are positively correlated with feacal/flatal incontinence (FFI) (p = 0.024 and p = 0.037). Hiatal areas at rest, pelvic contraction, Valsalva and detrussor muscle thickness are correleated with age (r = 0.287, r = 0.335, r = 0.315 and r = 0.421 respectively), body mass index (r = 0.380, r = 0.420, r = 0.415 and r = 0.447 respectively) and pelvic floor muscle strength (r = –0.539, r = –0.583, r = –0.550 and r = –0.545 respectively). Bladder neck descent is correlated with body mass index (r = 0.284). **Conclusions**: Transperineal ultrasound measurements of Detrusor muscle thickness, hiatal area (HA) at rest, pelvic contraction and Valsalva Manoeuvre are found to be associated with PFDs in pregnant women. Risk factors for PFDs in pregnancy are body mass index, age, gestational week, parity, birth weight and delivery method.

Keywords: fecal incontinence; pelvic floor dysfunction; pelvic floor disorders; pelvic floor ultrasonography; pelvic organ prolapse; translabial ultrasonography; transperineal ultrasonography; pregnancy; sexual dysfunction; urinary incontinence

1. Introduction

Pelvic floor dysfunctions (PFD) consist of urinary incontinence, fecal/flatal incontinence, sexual dysfunction, pelvic organ prolapse and pelvic pain. This common problem negatively affects quality of life and creates an economic burden on health-care systems [1]. The prevalence in pregnancy is reported as high as 41.8% [2]. The main risk factors are pregnancy, birth, body mass index (BMI) and age.

Genito-pelvic dysfunctions are frequently seen especially in pregnancy due to various reasons such as progesterone level decrease, smooth muscle relaxation, increased abdominal pressure and alterations of the connective tissue [3]. The most common sonographic pelvic floor changes are increases in urethro-vesical angle, urethral mobility, detrusor muscle thickness and hiatal dimensions as well as levator ani injuries which are connected to PFDs in pregnancy [4]. In addition to its use in pelvic floor dysfunctions, transperineal ultrasonography is also commonly used in many different indications such as labor management [5], obstetric tears [6], outcomes of mid-urethral tape surgery [7] and so on.

Although widely seen in the pregnant population, PFD is under-reported due to social and cultural restrictions and in some cases because it is considered inevitable. Early diagnosis of PFD or identifying the risk factors is crucial for antenatal care. Transperineal ultrasonography is a well-tolerated, noninvasive method to identify pelvic floor changes in pregnancy.

This study aims to combine the data obtained from transperineal ultrasonography with PFMS examination and questionnaires. The possible use of transperineal ultrasonography for screening pelvic floor disorders in pregnancy will be evaluated.

2. Material and Methods

188 women who were admitted to our antenatal clinic between October-December 2019 were informed about the

nature and progress of the study. Exclusion criteria were multiple pregnancies, women who had more than one delivery, women with preterm birth risk and placenta invasion or implantation abnormalities. 119 women were enrolled in the study. 45 of them were not present for their followups and 25 of them were excluded from the study due to obstetric complications such as abortus, preterm delivery and pregnancy termination because of fetal anomalies. 49 women left were included in the study.

Approval of the Ethics Committee was acquired (2019/954, Istanbul Faculty of Medicine, Ethics Committee). The study was operated according to the Good Clinical Practices Guideline of Helsinki. Personal Data Protection Act principles were abided.

An independent doctor obtained the anamnesis of the women. After that, the questionnaires were filled with the help of a second independent doctor. The validated Turkish versions of Short Form-36 (SF-36) [8], Pelvic Floor Distress Inventory (PFDI) [9], Incontinence Impact Questionnaire (IIQ-7) [9] and Female Sexual Function Index (FSFI) [10] were used. All investigators were blinded to the questionnaire results until the study was completed.

According to the questionnaire results, the women with stress urinary incontinence (SUI), urge urinary incontinence (UUI), fecal/flatal incontinence (FFI), pelvic organ prolapse (POP), sexual dysfunction (SD) and pelvic pain (PP) were categorized. SUI data were extracted from the 15th and 16th questions, UUI data from the 17th and 18th questions, fecal incontinence data from 9th and 10th questions, flatal incontinence data from the 11th question, POP data from 3rd, 4th and 6th questions of PFDI. PP was assessed by the 7th column of SF36 questionnaire and by the pain subgroup of FSFI. The cutoff value for SD on FSFI was considered to be 26.55 [11]. Patients then were categorized into groups such as SUI and non-SUI, UUI and non-UUI, FFI and non-FFI, POP and non-POP, SD and non-SD, PP and non-PP.

Unaware of the results from the questionnaires, a third doctor performed transperineal ultrasonography (Toshiba Aplio 500) to measure bladder neck descent (BND) [12], pubovisceralis muscle thickness [13], bladder detrussor muscle thickness (obtained from the mean of 3 measurements from the anterior wall, trigone and dome) [14], hiatal area (HA) during rest, Valsalva Maneuver (VM) and pelvic contraction [15]. The measurements were made after bladder emptying and repeated 3 times to get an average [12].

A fourth independent doctor evaluated the PFMS via Modified Oxford Scale and PERFECT scheme [16].

Age, BMI, gestational week, trimester, parity, the last birth weight and delivery method (if any), educational status, PFMS and transperineal ultrasound parameters (pubovisceralis muscle thickness, BND, detrussor muscle thickness, HA at rest, VM and contraction) were analyzed between groups SUI and non SUI, UUI and non UUI, FFI and non FFI, POP and non-POP, SD and non-SD, PP and non PP. Statistical analysis made by NCSS (Number Cruncher Statistical System) 2007 (Kaysville, USA).

3. Results

The demographics of the patient group are demonstrated in Table 1. There are 6 women on first, 21 on second and 22 in the third trimester of their pregnancies. 30 women are nulliparous whereas 19 women are multiparous, 9 with one vaginal delivery and 10 with one Caesarean delivery.

Table 1. Characteristics of the patient group.

n = 49	Average ± SD	Min–Max
Age	28.22 ± 6.08	18–42
BMI	27.72 ± 6.77	16.80–42.20
Gestational week	23.27 ± 7.95	9–34

Table 2 summarizes the transperineal ultrasound measurements.

Table 3 summarizes the demographics and ultrasound measurement comparisons between those with PFDs and those without. The prevalance of SUI is 51%, UUI 73.5%, FFI 40.8%, POP 26.5%, SD 71.4% and PP 38.8% in this sample group.

3.1 Transperineal Ultrasound Measurements and Pelvic Floor Dysfunctions in Pregnancy

Detrusor muscle thickness, hiatal area at rest, VM and contraction are found to be higher in the SUI group than the non-SUI group (p = 0.002, 0.018, 0.006 and 0.014 respectively, $p < 0.05$).

In the UUI group, hiatal area at VM and detrusor muscle thickness are found to be higher than the non UUI group (p = 0.002 and 0.02 respectively, $p < 0.05$).

Hiatal area at VM and contraction are found to be greater in the FFI group then the non FFI group (p = 0.037 and 0.024 respectively, $p < 0.05$).

In the POP group, hiatal area at rest, VM and contraction are found to be greater than the non-POP group (p = 0.015, 0.011 and 0.022 respectively, $p < 0.05$.)

In the SD group, hiatal area at rest, VM and contraction are found to be greater than the non-SD group (p = 0.033, 0.023 and 0.041 respectively, $p < 0.05$).

3.2 Risk Factors for Pelvic Floor Dysfunctions in Pregnancy

Transperineal ultrasound measurements‘ correlations with patient characteristics and pelvic floor muscle strength are demonstrated in Table 4.

In the SUI group, age, BMI, gestational week and fetal weight of the previous delivery (if any) are found to be greater than the non SUI group (p = 0.001, 0.001, 0.01 and 0.04 respectively, $p < 0.05$). PFMS is found to be less in the SUI group (p = 0.001, $p < 0.05$).

Table 2. Transperineal ultrasound measurements.

n = 49	Average ± SD	Min–Max
Pubovisceralis Muscle Thickness (mm)	18.83 ± 6.27	7.10–36.80
Detrussor Muscle Thickness (mm)	5.81 ± 2.27	2.10–12.62
Hiatal Area at Rest (mm^2)	1598.5 ± 337.0	953.0–2240.0
Hiatal Area at VM (mm^2)	1741.6 ± 376.1	1002.0–2356.0
Hiatal Area at Contraction (mm^2)	1520.9 ± 326.2	906.0–2225.0
Bladder Neck Descent (mm)	6.08 ± 6.19	0.20–31.60

Table 3. The demographics' and ultrasound measurements' comparisons between those with PFD subgroups and those without.

	SUI	UUI	FFI	POP	SD	PP
Age	^{a}0.001**	^{a}0.055	^{a}0.001**	^{a}0.002**	^{a}0.026*	^{a}0.137
BMI	^{a}0.001**	^{a}0.086	^{a}0.019*	^{a}0.002**	^{a}0.180	^{a}0.051
Fetal weight of the previous birth	^{a}0.04*	^{a}0.354	^{a}0.007**	^{a}0.104	^{a}0.958	^{a}0.264
Pubovisceralis muscle thickness	^{a}0.785	^{a}0.716	^{a}0.335	^{a}0.413	^{a}0.310	^{a}0.949
Hiatal Area at Rest	^{a}0.018*	^{a}0.116	^{a}0.051	^{a}0.015*	^{a}0.033*	^{a}0.139
Hiatal Area at VM	^{a}0.006**	^{a}0.054	^{a}0.037*	^{a}0.011*	^{a}0.023*	^{a}0.103
Hiatal Area at contraction	^{a}0.014*	^{a}0.084	^{a}0.024*	^{a}0.022*	^{a}0.041*	^{a}0.116
Gestational Week	^{b}0.01**	^{b}0.313	^{b}0.041*	^{b}0.068	^{b}0.069	^{b}0.002**
Pelvic Floor Muscle Strength	^{b}0.001**	^{b}0.004**	^{b}0.002**	^{b}0.004**	^{b}0.001**	^{b}0.001**
Bladder Neck Descent	^{b}0.085	^{b}0.794	^{b}0.951	^{b}0.642	^{b}0.690	^{b}0.218
Detrussor Muscle Thickness	^{b}0.002**	^{b}0.002**	^{b}0.001**	^{b}0.230	^{b}0.650	^{b}0.020*

a: Student *T* Test; b: Mann-Whitney U Test; $*p < 0.05$, $**p < 0.01$.

Table 4. The perineal ultrasound measurements correlations with patient characteristics.

		1	2	3	4	5	6	7	8	9	10
1. Age	r	1									
	p	.									
2. BMI	r	0.577	1								
	p	0.001**	.								
3. Fetal Weight of the previous birth	r	0.525	0.562	1							
	p	0.021*	0.012*	.							
4. Muscle Strength	r	–0.611	–0.712	–0.554	1						
	p	0.001**	0.001**	0.014*	.						
5. BND	r	0.228	0.284	–0.01	–0.273	1					
	p	0.114	0.048*	0.969	0.058	.					
6. HA Rest	r	0.287	0.38	0.231	–0.539	0.227	1				
	p	0.046*	0.007**	0.341	0.001**	0.116	.				
7. HA VM	r	0.315	0.415	0.358	–0.550	0.278	0.953	1			
	p	0.028*	0.003**	0.133	0.001**	0.053	0.001**	.			
8. HA contraction	r	0.335	0.42	0.202	–0.583	0.153	0.964	0.934	1		
	p	0.019*	0.003**	0.406	0.001**	0.294	0.001**	0.001**	.		
9. Pubovisceralis thickness	r	–0.235	–0.103	–0.107	0.143	0.068	–0.285	–0.360	–0.358	1	
	p	0.105	0.483	0.662	0.326	0.642	0.048*	0.011*	0.012*	.	
10. Detrussor Thickness	r	0.421	0.447	0.099	–0.545	0.218	0.385	0.374	0.425	0.004	1
	p	0.003**	0.001**	0.686	0.001**	0.133	0.006**	0.008**	0.002**	0.976	.

Spearman's Correlation $*p < 0.05$ $**p < 0.01$.

PFMS is found to be less in the UUI group ($p = 0.004$, $p < 0.05$).

In the FFI group, age, BMI, fetal weight of the previous delivery (if any) and gestational week are found to be higher than the non FFI group ($p = 0.001$, 0.019, 0.007 and 0.041 respectively, $p < 0.05$). PFMS is found to be significantly less in the FFI group ($p = 0.002$, $p < 0.05$).

In the POP group; age and BMI are found to be higher than the non-POP group ($p = 0.002$ and 0.002 respectively, $p < 0.05$). PFMS is found to be significantly less in the POP group ($p = 0.004$, $p < 0.05$). POP incidence in pregnancy is significantly different between nulliparous women, vaginal delivery group and c-section group (Fisher exact test; r = 7.964, $p = 0.013$ and $p < 0.05$). Nulliparous women and c-section group have lower incidence of POP than the vaginal delivery group.

Age is found to be higher in SD group ($p = 0.026$, $p < 0.05$). PFMS is found to be significantly less in SD group ($p = 0.011$, $p < 0.05$). A significant difference between the educational status of the SD and non-SD groups is found (Fisher exact test: r = 11.21, $p = 0.013$ and $p < 0.05$). SD incidence is greater in the primary and secondary education groups than higher educational groups.

In PP group, gestational week is found to be greater than non-PP group ($p = 0.002$, $p < 0.05$). PFMS is found to be less in PP group ($p = 0.001$, $p < 0.05$). PP incidence differs significantly between trimesters (Fisher exact test; r = 8.26, $p = 0.012$ and $p < 0.05$).

3.3 Transperineal Ultrasonography Measurements between Trimesters

Hiatal area at contraction and detrusor muscle thickness vary significantly between trimesters ($p = 0.025$ and $p = 0.006$ respectively; $p < 0.05$). Hiatal area at contraction is lower in 2nd trimester than 3rd ($p = 0.001$, $p < 0.01$). Thickness of the detrusor muscle is lower in first trimester than 2nd and 3rd ($p = 0.001$; $p < 0.01$). PFMS differs significantly between trimesters ($p = 0.002$; $p < 0.01$). PFMS is greater in first trimester than 2nd and 3rd and greater in 2nd trimester than 3rd ($p = 0.001$ and $p = 0.001$ respectively; $p < 0.01$).

3.4 Transperineal Ultrasonography Measurements and Parity/ Delivery Method

BND, hiatal area measurement at contraction and detrusor muscle thickness significantly differ between nulliparous women, vaginal and caesarean delivery groups ($p = 0.046$, $p = 0.028$ and $p = 0.002$ respectively; $p < 0.05$). BND is greater in c-section group than nulliparous ($p = 0.001$; $p < 0.01$). In the vaginal delivery group, hiatal area at contraction is higher than nulliparous group ($p = 0.001$; $p < 0.01$). In the nulliparous group, detrusor muscle thickness is significantly lower than both the vaginal and the caesarean section delivery group ($p = 0.001$; $p < 0.01$).

3.5 Transperineal Ultrasonography Measurements and Age

Age is found to be weakly positively correlated with hiatal areas at rest, VM and contraction (r = 0.287, r = 0.315 and r = 0.335 respectively; $p < 0.05$). Age is found to be moderately positively correlated with detrusor muscle thickness (r = 0.421; $p < 0.01$). Age is moderately negatively correlated with pelvic floor muscle strength (r = –0.611; $p < 0.01$).

3.6 Transperineal Ultrasonography Measurements and BMI

BMI is found to be weakly positively correlated with BND and hiatal area at rest (r = 0.284; $p < 0.05$ and r = 0.380; $p < 0.01$ respectively). BMI is found to be moderately positively correlated with hiatal area at VM, contraction and also detrusor muscle thickness (r = 0.415; $p < 0.05$, r = 0.420; $p < 0.01$ and r = 0.447; $p < 0.01$ respectively). BMI and PFMS are strongly negatively correlated (r = –0.712; $p < 0.01$).

3.7 Transperineal Ultrasonography Measurements and PFMS

PFMS was determined by the Modified Oxford Scale and PERFECT scheme [10] with 4 parameters and each parameter showed consistent results with each other and the Modified Oxford Scale.

PFMS is moderately negatively correlated with HA at rest, VM, contraction and also with detrusor muscle thickness (r = –0.539, r = –0.550, r = –0.583 and r = –0.545; $p < 0.01$ respectively).

4. Discussion

The hiatal area at rest, pelvic contraction, Valsalva, and detrusor muscle thickness are found to be positively correlated with PFD incidence in this study.

4.1 Detrusor Muscle Thickness

Detrusor muscle thickness is found to be affected by BMI, trimester, parity, previous delivery type and PFMS. In SUI and UUI groups, detrusor muscle thickness is greater, which is consistent since the study also found that UI incidence is greater with these risk factors. Dietz [17] reported that greater detrusor muscle thickness increases UI incidence and suggested the cut-off value of 5 mm.

4.2 Hiatal Area

In this study hiatal area is found to be affected by age, BMI, parity, and previous birth weight. These risk factors also adversely affect pelvic floor muscle strength, which coincides with the literature. Delivery, especially vaginal delivery, is a well-established cause for ballooning of the levator hiatus (hiatal area greater than 25 cm^2 in VM) [18]. Falkert *et al*. [19] reported significantly greater hiatal area in the vaginal delivery compared to the c-section group. A study conducted by Aydin *et al*. [20] reported that HA at rest is not related to sexual functions but hiatal diameter at VM may be a sign of laxity and is weakly associated with sexual function. Although current literature doesn't have any solid data on incontinence and hiatal area relationship, our study concluded that not only pelvic organ prolapse but also incontinence and sexual dysfunction are correlated with greater hiatal area (especially at contraction and VM). This may be since all PFDs tend to concomitantly occur because of their common physiopathology.

4.3 Bladder Neck Descent

Higher BND is found to be related with higher BMI, parity, and vaginal delivery in primiparous women. Even though these risk factors are also found to be related with antenatal SUI in this study, no correlation is found between BND measurements and SUI. Previous literature considered increased BND represents urethral hypermobility [21] however recent studies show that urethral hypermobility, therefore the risk for SUI, is indeed more related to the mobility of midurethra [22].

4.4 Pubovisceralis Muscle

Pelvic floor muscles play a crucial role in sexual functions especially in arousal, lubrication and orgasm [23]. Although a relationship was expected to be found between pubovisceralis muscle thickness and sexual function, no correlations were found. One reason might be that the patients who engage in coitus during pregnancy are rare in this sample population. Another reason might be that pubovisceralis muscle thickness might not be related to muscle strength since the study did not conclude a correlation between pubovisceralis muscle thickness and pelvic floor muscle strength either. Graber *et al*. [24] reported that pubovisceralis muscle is stronger in orgasmic women than anorgasmic ones, but no data was given on the muscle thickness hence further research is required.

4.5 Age

Age is determined as an important risk factor for SUI, FFI, SD and POP in this study. Aging causes pelvic floor disorders due to its negative effect on PFMS, as also shown in this study. Chan *et al*. [25] conducted an observational study with 405 nulliparous pregnant women and reported that age is a risk factor for antenatal SUI. An epidemiological study including 1330 women reported that UI is likely to be accompanied by FFI and POP since they all have the same underlying pathological mechanisms as aging [26]. As age increases antenatal complications and comorbidities increase as well, which affects sexual functions adversely. Also, many studies reported that sexual desire decreases with age. In a study including 306 pregnant women, it is found that women aged over 35 had lower scores in desire and satisfaction subcategories of FSFI [27].

As the communities evolve, women have a greater share in the working population that causes older-aged pregnancies. Also assisted reproductive techniques help achieve older pregnancies. Therefore, pelvic floor dysfunctions increasing with age needs higher attention in our daily practice.

4.6 Body Mass Index

Obesity is an emerging healthcare problem causing many comorbidities in the population. With increased BMI, the forces on the pelvic floor increase which results in PFDs. Therefore, higher BMI is an avoidable risk factor for PFDs. In this study SUI, FFI and POP incidences are found to be greater in higher BMI patients. In addition to the increased forces on the pelvic floor, SUI is also related to the hypermobility of the bladder neck which increases with weight [28]. Even as minor as 5–10% loss of the bodyweight combined with lifestyle alterations showed an encouraging decrease in UI [29] which proves the high impact of BMI on UI. Moreover, in a study conducted by Richter *et al*. [30], the prevalence of anal incontinence was found to be 32% in morbidly obese patients. Also POP and BMI relation is proved by a comprehensive review put together by Jelovsek *et al*. [31]. Although it is known that urgency symptoms increase with increasing BMI due to abdominal pressure and impaired bladder innervation, our study could not detect such a relationship. The reason may be that our study only investigated urge urinary incontinence and not the other lower urinary tract dysfunctions. Being overweight causes not only adverse effects on the pelvic floor but also constitutes a higher risk for maternal and fetal complications in pregnancy. Since obesity rates incline in the population, weight management counseling should be a routine part of preconception and antenatal care.

4.7 Gestational Week

The study showed that SUI and FFI incidences are greater later in the pregnancy. The increased forces on the pelvic floor can explain this relationship. Both increased weight and increased abdominal pressure contribute to the incontinence mechanism. According to a metanalysis by Sydow [32] which contains 59 studies, sexual function differs between trimesters. Even though our study could not show any relationship between sexual dysfunction and gestational week, which contradicts with the literature, we showed that pregnant women who did not engage in coitus are significantly higher as the gestational week increases. Serati *et al*.'s [33] review also proved that sexual functions are negatively affected by pregnancy, especially in the last trimester. In our study, pelvic pain is found to be more frequent as pregnancy advances. Pelvic pain mechanism can be secondary to uterine contractions, increased abdominal pressure and compression neuropathies, which increase later in the pregnancy.

4.8 Delivery Method

Regardless of the delivery method, it is known that pregnancy causes defects on pelvic floor. Interpreting the data collected in our study led to the conclusion that SUI and FFI incidences are lower in nulliparous women. Chan *et al*. [34] showed that pregnancy over 35 weeks has an adverse impact on pelvic floor in both vaginal delivery and c-section group. In our study, it is found that not only nulliparous women but also the c-section group have a lower incidence of POP than the vaginal delivery group.

4.9 Education

In this study lower educational status is found to be a risk factor for sexual dysfunction in pregnancy. As educational status improves, access to information and self-esteem increases which positively affects sexual function. In Eryilmaz *et al*.'s [35] study including 238 pregnant women, 61.4% told that they think coitus in pregnancy carries a risk to the mother and the unborn. In our study, we found that 42.8% of women do not engage in coitus at all during pregnancy. A study conducted by Guleroglu *et al*. [27] with 306 pregnant women enrolled, showed that not only the mother's but also the father's lower educational status affected sexual functions adversely. Thus attentive sexual education should be given to especially those who don't have easy access to credible information sources.

4.10 Pelvic Floor Muscle Strength

This study found that age, BMI, trimester, parity, and fetal weight of the previous birth adversely affects pelvic floor muscle strength, causing every subgroup of PFDs. Literature also shows that PFMS is in a negative relationship with PFDs except for pelvic pain. Data on pelvic pain is contradictory. Hypertonic pelvic floor is an established risk factor for chronic pelvic pain and sexual pain disorders [36]. Patients with levator muscle spasms have higher pain scores although the relationship with muscle strength is unknown. Further research is required in pregnant women. The impact of pelvic floor exercises on UI and SD in pregnancy are analyzed in two reviews and both showed improvement in the exercise groups [37,38].

4.11 Limitations

There were some limitations of this study. First, this study was performed as a cross-sectional observational study and the sample size was relatively small. An ideal study should be a prospective observational study involving pre-pregnancy, all three trimesters and postpartum periods of the same women as their control. To overcome this obstacle, an ongoing study is being performed. Secondly, pelvic floor muscle strength determination with a perineometer would obtain quantitative data therefore would be more beneficial, but since pregnant women find penetrative examinations uncomfortable and considering Turkey's partially conservative population, no perineometer could be used. Because of the same reasons, POP-Q quantification performed with valves was not used in the study. Lastly, Q tip test for urethral hypermobility would also be favorable to collect numeric data for comparison however this was not considered appropriate for the pregnant population because of the infectious risks.

Also, it is proved that pregnancy and parturition traumas on pelvic floor might be temporary [39]. Therefore, when analyzing the risk factor and correlations, the time passed since delivery should also be considered. Shek and Dietz [40] conducted a study that only nulliparous women were enrolled and postpartum follow-up periods were planned to be similar (average 5.3 months). Also, a comprehensive cohort that takes into account epidural analgesia, elective or emergency c-section and prolonged second stage labor would be more informative.

5. Conclusions

The hiatal area values of rest, VM, pelvic contraction as well as detrusor muscle thickness on transperineal ultrasound are related with PFDs and lower PFMS in pregnancy. In pregnant women the risk factors for pelvic floor dysfunctions are body mass index, age, gestational week, parity, delivery method and birth weight.

Elaborate anamnesis with the help of questionnaires targeting PFDs when needed, transperineal USG screening and digital examination to assess pelvic muscle strength at the preconception or first antenatal visit might be beneficial for taking preventive measures concerning pelvic floor dysfunctions during and after pregnancy.

Author Contributions

IST—Project development, patient recruitment, data collection, data analysis and manuscript writing. CY—Project development, ultrasonography measurements and manuscript writing. FGU—Physical examination and data analysis. AY—Project development and questionnaires.

Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by Istanbul Faculty of Medicine, Ethics Committee (approval number 2019/954). Document can be presented upon request.

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Conflict of Interest

The authors declare no conflict of interest.

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